

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

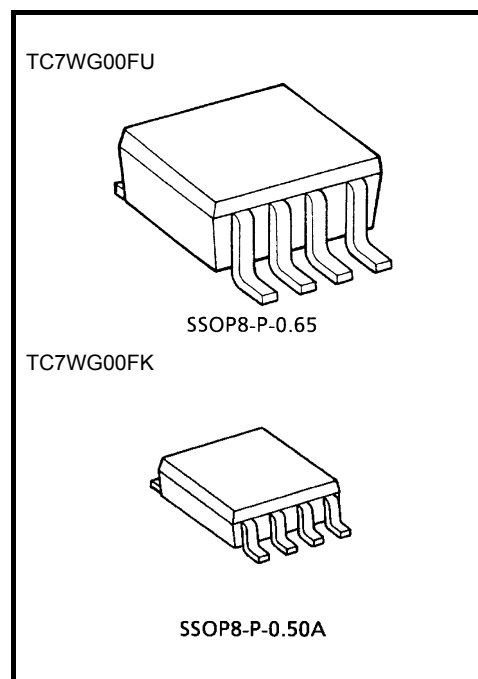
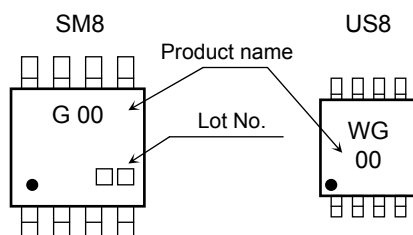
# TC7WG00FU, TC7WG00FK

Dual 2-Input NAND Gate

## Features

- High-level output current:  $I_{OH}/I_{OL} = \pm 8 \text{ mA (min)}$   
at  $V_{CC} = 3 \text{ V}$
- High-speed operation:  $t_{pd} = 2.5 \text{ ns (typ.)}$   
at  $V_{CC} = 3.3 \text{ V}, 15 \text{ pF}$
- Operating voltage range:  $V_{CC} = 0.9 \sim 3.6 \text{ V}$
- 5.5-V tolerant inputs
- 3.6-V power down protection outputs

## Marking

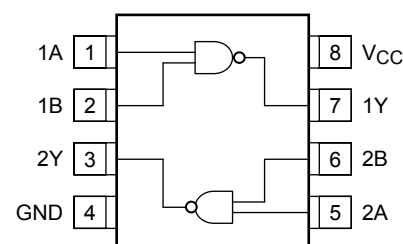


Weight  
 SSOP8-P-0.65 : 0.02 g (typ.)  
 SSOP8-P-0.50A : 0.01 g (typ.)

## Absolute Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

Characteristics	Symbol	Value	Unit
Power supply voltage	$V_{CC}$	$-0.5 \sim 4.6$	V
DC input voltage	$V_{IN}$	$-0.5 \sim 7.0$	V
DC output voltage	$V_{OUT}$	$-0.5 \sim 4.6$ (Note 1)	V
		$-0.5 \sim V_{CC} + 0.5$ (Note 2)	
Input diode current	$I_{IK}$	-20	mA
Output diode current	$I_{OK}$	-20 (Note 3)	mA
DC output current	$I_{OUT}$	$\pm 25$	mA
DC $V_{CC}$ / ground current	$I_{CC}$	$\pm 50$	mA
Power dissipation	$P_D$	300 (SM8) 200 (US8)	mW
Storage temperature	$T_{stg}$	$-65 \sim 150$	$^\circ\text{C}$

## Pin Assignment (top view)



Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/Derating Concept and Methods) and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

Note 1:  $V_{CC} = 0 \text{ V}$

Note 2: High or Low State.  $I_{OUT}$  absolute maximum rating must be observed.

Note 3:  $V_{OUT} < \text{GND}$

## IEC Logic Symbol



## Truth Table

Inputs		Outputs
A	B	Y
L	L	H
L	H	H
H	L	H
H	H	L

## Operating Ranges

Characteristics	Symbol	Value	Unit
Power supply voltage	$V_{CC}$	0.9~3.6	V
Input voltage	$V_{IN}$	0~5.5	V
Output voltage	$V_{OUT}$	0~3.6 (Note 4)	V
		0~ $V_{CC}$ (Note 5)	
Output Current	$I_{OH}/I_{OL}$	$\pm 8.0$ (Note 6)	mA
		$\pm 4.0$ (Note 7)	
		$\pm 3.0$ (Note 8)	
		$\pm 1.7$ (Note 9)	
		$\pm 0.3$ (Note 10)	
		$\pm 0.02$ (Note 11)	
Operating temperature	$T_{opr}$	-40~85	°C
Input rise and fall time	dt/dV	0~10 (Note 12)	ns/V

Note 4:  $V_{CC} = 0V$

Note 5: High or Low state.

Note 6:  $V_{CC} = 3.0\sim 3.6 V$

Note 7:  $V_{CC} = 2.3\sim 2.7 V$

Note 8:  $V_{CC} = 1.65\sim 1.95 V$

Note 9:  $V_{CC} = 1.4\sim 1.6 V$

Note 10:  $V_{CC} = 1.1\sim 1.3 V$

Note 11:  $V_{CC} = 0.9 V$

Note 12:  $V_{IN} = 0.8\sim 2.0 V$ ,  $V_{CC} = 3.0 V$

## Electrical Characteristics

## DC Characteristics

Characteristics		Symbol	Test Condition		Ta = 25°C				Ta = -40~85°C		Unit
					V <sub>CC</sub> (V)	Min	Typ.	Max	Min	Max	
Input voltage	High level	V <sub>IH</sub>	—		0.9	V <sub>CC</sub>	—	—	V <sub>CC</sub>	—	V
					1.1~1.3	V <sub>CC</sub> × 0.7	—	—	V <sub>CC</sub> × 0.7	—	
					1.4~1.6	V <sub>CC</sub> × 0.65	—	—	V <sub>CC</sub> × 0.65	—	
					1.65~1.95	V <sub>CC</sub> × 0.65	—	—	V <sub>CC</sub> × 0.65	—	
					2.3~2.7	1.7	—	—	1.7	—	
					3.0~3.6	2.0	—	—	2.0	—	
	Low level	V <sub>IL</sub>	—		0.9	—	—	GND	—	GND	
					1.1~1.3	—	—	V <sub>CC</sub> × 0.3	—	V <sub>CC</sub> × 0.3	
					1.4~1.6	—	—	V <sub>CC</sub> × 0.35	—	V <sub>CC</sub> × 0.35	
					1.65~1.95	—	—	V <sub>CC</sub> × 0.35	—	V <sub>CC</sub> × 0.35	
					2.3~2.7	—	—	0.7	—	0.7	
					3.0~3.6	—	—	0.8	—	0.8	
Output voltage	High level	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -0.02 mA	0.9	0.75	—	—	0.75	—	V
				I <sub>OH</sub> = -0.3 mA	1.1~1.3	V <sub>CC</sub> × 0.75	—	—	V <sub>CC</sub> × 0.75	—	
				I <sub>OH</sub> = -1.7 mA	1.4~1.6	V <sub>CC</sub> × 0.75	—	—	V <sub>CC</sub> × 0.75	—	
				I <sub>OH</sub> = -3.0 mA	1.65~1.95	V <sub>CC</sub> -0.45	—	—	V <sub>CC</sub> -0.45	—	
				I <sub>OH</sub> = -4.0 mA	2.3~2.7	2.0	—	—	2.0	—	
				I <sub>OH</sub> = -8.0 mA	3.0~3.6	2.48	—	—	2.48	—	
	Low level	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub>	I <sub>OL</sub> = 0.02 mA	0.9	—	—	0.1	—	0.1	
				I <sub>OL</sub> = 0.3 mA	1.1~1.3	—	—	V <sub>CC</sub> × 0.25	—	V <sub>CC</sub> × 0.25	
				I <sub>OL</sub> = 1.7 mA	1.4~1.6	—	—	V <sub>CC</sub> × 0.25	—	V <sub>CC</sub> × 0.25	
				I <sub>OL</sub> = 3.0 mA	1.65~1.95	—	—	0.45	—	0.45	
				I <sub>OL</sub> = 4.0 mA	2.3~2.7	—	—	0.4	—	0.4	
				I <sub>OL</sub> = 8.0 mA	3.0~3.6	—	—	0.4	—	0.4	
Input leakage current		I <sub>IN</sub>	V <sub>IN</sub> = 0~5.5V	0~3.6	—	—	±0.1	—	±1.0	μA	
Power off leakage current		I <sub>OFF</sub>	V <sub>IN</sub> = 0~5.5V V <sub>OUT</sub> = 0~3.6V	0	—	—	1.0	—	10.0	μA	
Quiescent supply current		I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	3.6	—	—	1.0	—	10.0	μA	

AC Characteristics (Input:  $t_r = t_f = 3 \text{ ns}$ )

Characteristics	Symbol	Test Condition	Ta = 25°C				Ta = -40~85°C		Unit
			VCC (V)	Min	Typ.	Max	Min	Max	
Propagation delay time	t <sub>pLH</sub> t <sub>pHL</sub>	C <sub>L</sub> = 10 pF, R <sub>L</sub> = 1 MΩ	0.9	—	26.9	—	—	—	ns
			1.1~1.3	—	10.9	20.7	1.0	38.6	
			1.4~1.6	—	5.9	9.6	1.0	11.3	
			1.65~ 1.95	—	4.5	7.0	1.0	7.5	
			2.3~2.7	—	2.9	4.4	1.0	4.9	
			3.0~3.6	—	2.2	3.5	1.0	4.1	
		C <sub>L</sub> = 15 pF, R <sub>L</sub> = 1 MΩ	0.9	—	30.0	—	—	—	
			1.1~1.3	—	12.0	24.2	1.0	42.0	
			1.4~1.6	—	6.5	10.5	1.0	12.6	
			1.65~ 1.95	—	5.0	7.7	1.0	8.0	
			2.3~2.7	—	3.2	4.9	1.0	5.6	
			3.0~3.6	—	2.5	3.8	1.0	4.4	
		C <sub>L</sub> = 30 pF, R <sub>L</sub> = 1 MΩ	0.9	—	45.0	—	—	—	
			1.1~1.3	—	18.0	33.4	1.0	63.2	
			1.4~1.6	—	8.9	14.8	1.0	17.9	
			1.65~ 1.95	—	6.9	10.3	1.0	10.8	
			2.3~2.7	—	4.4	6.4	1.0	6.8	
			3.0~3.6	—	3.5	4.9	1.0	5.4	
Input capacitance	C <sub>IN</sub>	—	3.6	—	3	—	—	pF	
Power dissipation capacitance	C <sub>PD</sub>	(Note13)	0.9 ~ 3.6	—	10	—	—	pF	

Note 13:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

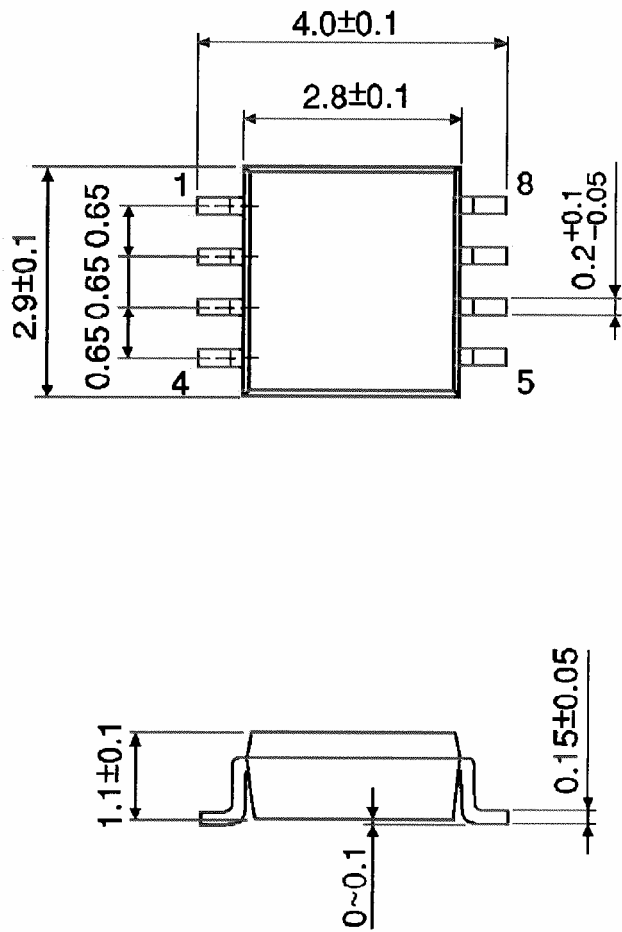
Average operating current can be obtained by the equation:

$$I_{CC}(\text{opr.}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2$$

Package Dimensions

SSOP8-P-0.65

Unit : mm

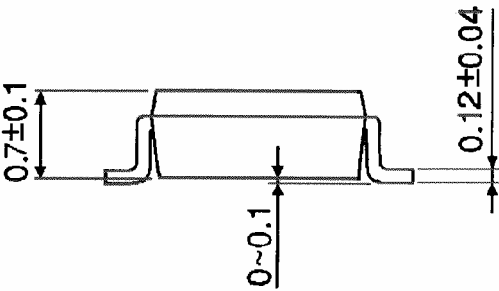
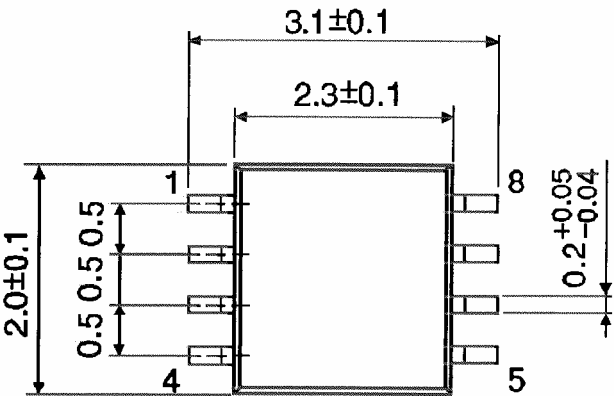


Weight: 0.02 g (typ.)

Package Dimensions

SSOP8-P-0.50A

Unit : mm



Weight: 0.01 g (typ.)

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20070701-EN GENERAL

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